

California High Speed Rail Authority

Strategic Energy Plan

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Executive Summary

This Strategic Energy Plan (SEP) was developed through the sustainability partnership between the California High Speed Rail Authority and United States Department of Transportation, Federal Railroad Administration, United States Department of Housing and Urban Development (Region 9), Federal Transit Administration (Region 9) and United States Environmental Protection Agency (Region 9). The creation of the SEP was funded through the Technical Assistance Program of the Department of Energy's (DOE) Energy Efficiency and Renewable Energy (EERE) Office.

This partnership was established by a memorandum of understanding (MOU) that serves as an umbrella agreement covering broad efforts to promote sustainability within the California high speed rail system. This MOU establishes a framework under which the signatory agencies can work together to promote the livability principles and achieve an environmentally sustainable high speed rail system in California. The MOU defines common goals, identifies key areas for collaboration, and defines expectations and terms for signatory agencies.

The signatory agencies recognize the need to plan, site, design, construct, operate, and maintain a high speed rail system using environmentally preferable practices in order to:

- Protect the health of California's residents and preserve California's natural resources; and
- Minimize air and water pollution, energy usage, and other environmental impacts.

The signatory agencies also recognize the significant and far-reaching benefits of a well-planned system, and share a common vision for a high speed rail system that, when combined with other planning efforts:

- Promotes sustainable housing and development patterns which recognize local goals and interests;
- Integrates station access and amenities into the fabric of surrounding neighborhoods;
- Stimulates multimodal connectivity and thereby increases options for affordable, convenient access to goods, Services, and employment;
- Reduces transportation emissions per passenger across California, thereby reducing associated environmental and health impacts;
- Protects ecologically sensitive and agricultural lands;
- Minimizes long-term operational costs; and
- Facilitates the building of a more robust and sustainable economy in California.

The Strategic Energy Plan has been developed to provide the signatory agencies and the California High Speed Rail Authority with guidelines to meet the goals established in the MOU. These guidelines are provided as a roadmap with which to develop and operate the high speed rail system.

California High Speed Rail Authority

Strategic Energy Plan

Background

The California High Speed Rail (HSR) project is an effort led by the California High Speed Rail Authority (CHSRA) to develop an approximately 800-mile high-speed train system serving California's major metropolitan areas and will include up to 24 stations. Full Phase 1 build out will run from San Francisco to Los Angeles/Anaheim via the Central Valley. Later segments will continue to Sacramento and San Diego. High-speed trains will travel between LA and San Francisco in under 2 hours and 40 minutes, at speeds of up to 220 mph, and will interconnect with other transportation alternatives, providing an environmentally friendly option to traveling by plane or car.

The CHSRA Board established its commitment to "power the train with clean renewable energy" in September 2008, and the HSR project intends to operate with 100% renewable energy.

The Strategic Energy Plan (SEP) provides a road map, outlining key strategies and listing supporting action items and crucial considerations to guide the CHSRA in meeting its commitment to power the train with 100% renewable energy. Various stakeholders were interviewed and surveyed to assess the current market and determine where potential challenges and barriers exist and how they may be overcome.

Vision

CHSRA has a vision of providing California with a state of the art train system that diversifies and expands California's economy, is sustainable and environmentally sensitive, and that links conveniently to current modes of transportation.

In fulfilling this vision, CHSRA not only will be placing California as the nation's leader in sustainable, efficient transportation but also will be laying the tracks for a more robust and diversified economy.

To fulfill this ambitious vision the CHSRA has three overarching goals:

- Power the high speed train system on 100% renewable energy,
- Foster a robust, sustainable economy in California, and
- Enact best practices for energy sustainability.

Key strategies have been outlined corresponding to each of these overarching goals along with recommended actions and considerations. These strategies are flexible and serve as guidance for accomplishing desired outcomes and will be evaluated and amended as needed.



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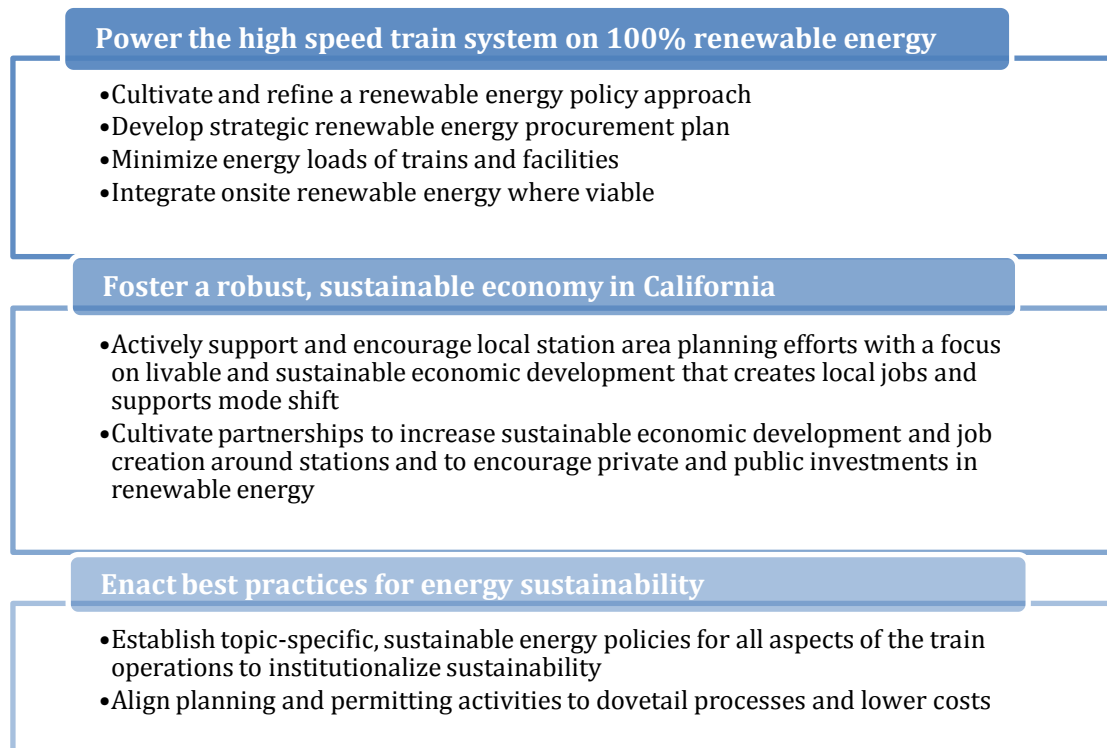
Strategic Energy Plan (SEP) Adoption

This document is meant to be discussed and circulated among California High Speed Rail Authority (CHSRA) board, staff, contractors and supporting organizations. The first step in implementing the strategies and actions listed in the SEP is the adoption of the plan itself. Adoption should take place at all levels of the CHSRA organization and encouraged for all affiliated and supporting organizations.¹ At the core of the SEP is the concept of sustainability. The Intergovernmental Panel on Climate Change (IPCC) defines sustainability as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”²

This definition aligns with the ultimate goal of the CHSRA, which is to provide transportation services that build strong communities, minimize degradation to the environment, and that are self-sustaining (economically and environmentally) over the long-term. Sustainability not only ensures the long-term viability of the HSR system but also positively affects long-term environmental and operational costs. The goals and strategies presented in the SEP aim to help accomplish CHSRA’s ultimate goal.

Highlighted within the SEP are actions and considerations intended to lead to meaningful progress toward building the high speed train system, powering the train and its operations with 100% renewable energy, and integrating it with California’s existing transportation infrastructure.

Overarching Goals and Outline of Key Strategies



¹ External adoption can be formalized through working group charters, MOUs, and petitions.

² IPCC Fourth Assessment Report: Climate Change 2007, Ch 12 Introduction quoting WCED, 1987; Bojo *et al.*, 1992. Online at http://www.ipcc.ch/publications_and_data/ar4/wg3/en/ch12s12-1.html.

Goals & Key Strategies

Goal: Power the High Speed Train System on 100% Renewable Energy

CHSRA's policy of powering the train operations with 100% renewable energy presents a tremendous opportunity for California to improve air quality, minimize environmental degradation, and meet its greenhouse gas reduction goals. The viability of this policy was supported by a feasibility study conducted in 2008 by Navigant which concluded that "integrating renewable energy into the HSR project would be neither cost- nor resource-prohibitive and would be well in line with the more sustainable future that California is trying to ensure for itself."³

Powering the train with 100% renewable energy will require a net-zero approach. While there are several different methods that can be used to determine net-zero operations, the basic concept is that the CHSRA will procure and produce enough new renewable energy to supply to the electric grid to offset any non-renewable energy loads used by the train. The net use of energy from the grid will equal the net supply of renewable energy fed into the grid. At present there are neither adequate financial and spatial resources, nor infrastructure available to power the train directly with 100% renewable energy. The high speed train operations require a highly reliable and stable source of power to minimize interruptions to train service from outages. The powerful trains will also represent a substantial load of approximately 20 megawatts (MW) which varies as the trains pass through the 30 mile electrical sections.

There are three key strategies for powering the train with 100% renewable energy that will be guided by the project's refined renewable energy policy. These strategies include: develop a strategic renewable energy procurement plan, continue to minimize energy loads, and integrate onsite renewable energy. Before taking actions to support these key strategies, CHSRA needs to define its net-zero energy approach and implement its renewable energy policy.

Once the CHSRA's net-zero energy approach has been finalized and adopted the foundation for action will be the development of a strategic renewable energy procurement plan that clarifies the mechanics of obtaining power from utilities. The CHSRA has started conversations with the four utility companies that have



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service areas along the proposed Phase 1 alignment between San Francisco and Anaheim. Memoranda of Understanding (MOUs) have been put in place with Pacific Gas and Electric (PG&E), Southern California Edison (SCE), Los Angeles Department of Water and Power (LADWP), and Anaheim Utilities. The MOUs have allowed for the exchange of technical information to determine probable sources at 115kV to 230kV levels, which are the levels the train system would require for operation. Additional agreements are needed to commence studies of the utility networks and analyze available energy sources for the high speed train network as well as availability of current transmission and distribution infrastructure.

The other two strategies (minimizing energy loads and implementing onsite renewable energy) that support the goal of powering the train with 100% renewable energy are being addressed daily by the CHSRA. The mission is focused on developing the requirements for the most safe, cost-effective, and efficient high-speed rail rolling stock and systems possible to minimize energy loads as well as determining viable options for the integration of onsite renewable energy at stations, along the rail, and at other facilities.

Strategies

CULTIVATE AND REFINE A RENEWABLE ENERGY POLICY APPROACH

CHSRA will need to decide which net-zero model they want to use to enable the train to be powered by 100% renewable energy. The questions answered through this refinement exercise will guide the strategic renewable energy procurement plan as it will set the parameters for measuring the renewable energy procured and generated by the CHSRA. The following decisions will need to be confirmed by CHSRA and will provide a foundation for the strategic renewable energy procurement plan.

³ Navigant Consulting, Inc. *The Use of Renewable Energy Sources to Provide Power to California's High Speed Rail* (2008) p.5.

Action Item: Define Net Zero Approach

CHSRA will need to decide the following:

- Will the requirements map to California's Renewable Portfolio Standards policy (i.e., will they use the same definition for 'renewable power', set thresholds for solar, etc.)
- Will renewable energy credits (RECs) be allowed? Does CHSRA want to allow RECs for the first 5-7 years of operation to cover any shortfalls that may occur in renewable energy procurement and/or generation as compared to grid energy consumed?
- What special considerations does CHSRA find important (e.g., does CHSRA want to provide a greater incentive for onsite renewable energy and/or for renewable energy developed on brownfield sites⁴)? Does CHSRA want to only count 'direct' renewable energy procurement and/or generation and forego RECs?

Waste to energy (WTE) is one way to generate power while helping others reduce their environmental impact.

Waste from dairy cattle or crops may benefit both CHSRA and farmers in the San Joaquin Valley if used to generate energy in a WTE plant.

DEVELOP STRATEGIC RENEWABLE ENERGY PROCUREMENT PLAN

CHSRA will need to engage many stakeholders in the electric utility industry to develop a detailed plan for renewable energy procurement. CHSRA will need to access the grid and the firm power it provides. Access to renewable energy sources to offset the power that HSR pulls from the grid would most likely need to be through tariff agreements which are used by the power companies to link specific customers with indicated sources, such as renewable energy. While the overall process for procuring power is quite basic, the intricacies of the planning instruments, regulatory constraints, and power purchase agreements (PPAs) involved in procuring renewable energy create a complex system for the CHSRA to navigate. This section will first provide the basic steps involved in procuring energy and then provide an overview of instruments and renewable energy power

⁴ Brownfield sites are defined by the EPA as having the "presence or potential presence of a hazardous substance, pollutant, or contaminant." More information about brownfields can be found at: <http://epa.gov/brownfields/overview/glossary.htm>

procurement options in California.

Actions included in the power procurement planning process are:

Action Item: Determine loads and locations

Since the initial estimates of the HSR loads which were used in the Navigant report⁵ more detailed studies have been performed using Traction Power Load Flow modeling software. The train pattern and frequency has been used to determine the forecasted loads throughout the system. In addition, the regenerative braking system on modern trains has been taken into account in the simulations to predict the amount of power which could be fed back from a decelerating train to other trains in the section, or into the utility network.

The computer simulations of the HSR system have shown that an approximate 30 mile spacing of power sources is required to meet the reliability and redundancy objectives under contingency scenarios. Therefore, existing transmission lines or high voltage substations have been identified which are in close proximity to the future rail line at these intervals. The goal of the interconnection planning process is to provide a robust service connection point, with the least impact to the area due to new line construction or modification.

As the utilities study their networks to determine the most economical and reliable way to supply the HSR system, they will also determine available renewable energy resources and locations for renewable energy feed-ins which may be appropriate to tie into the supply network at the HSR interconnection points.

Action Item: Work with the California Independent System Operator (CAISO) and utilities to ensure CHSRA's load, transmission, and interconnection needs are met

Transmission planning is a long-term process and is therefore being addressed in current planning, environmental compliance, and preliminary engineering stages. To ensure that CHSRA's needs are met at the time operations are scheduled to start it is crucial to:

- Determine what information CHSRA needs to provide CAISO to ensure the HSR loads are taken into consideration in the planning of the State's future energy needs⁶

⁵ Further assessment is needed as better estimates of loads are attained and as locations are determined with more accuracy.

⁶ Towards this end, the Project Team met with CAISO in 2009 to discuss the projected HSR loads and the need for transmission line interconnections at approximately 30 mile spacing along the route.

- Determine the projected loads for each utility interconnection point, as well as the feasibility of delivery of the necessary power to the HSR project substations.
- Include the utility modifications to transmission lines and substations in the HSR project Environmental Planning documents⁷.

The CHSRA Program Management Team (PMT) has determined the loads for the high speed train operations service pattern and begun formally transmitting them to the utility companies for input into their network capacity and feasibility studies. In addition, CHSRA has established regular technical exchange meetings with several of the primary utilities along the proposed route in order to closely coordinate with this important stakeholder group.

The CHSRA has included the environmental footprints of new substations and transmission lines in the environmental impact statement/environmental impact report (EIS/EIR) documents for the route segments. Further details will be included as the utility modifications are accurately determined, such that the CPUC permit processes for new high voltage facilities can be managed within the overall environmental approvals process for the project.

CHSRA has a designated staff member to coordinate with utilities. Currently the PMT Engineering Staff is collaborating with utilities on the planning and technical items associated with high voltage interconnections. These coordinating staff members have a strong understanding of CHSRA's needs, as well as how these needs should be represented regarding CAISO's processes and utility negotiations. Under the Master Agreements to be signed between the Authority and Utility Companies, the planning of interconnections and modifications will be a cooperative approach, such that the permits and designs can be encompassed in the overall HSR project documents.

Action Item: Work with utilities and renewable energy developers to identify renewable energy procurement and development options

- Confirm current renewable energy/green power programs that are accessible to CHSRA, such as the

Los Angeles Department of Water and Power's (LADWP) green power program⁸,

- Work with other utilities to develop green power programs that make green power procurement accessible to CHSRA, and
- Work with utilities and renewable energy developers to identify feasible renewable energy development options.

Both the engineering of the HSR project and the development of new large-scale power generation are 5 to 10 year efforts. These activities should be jointly progressed to ensure the goals of the Utilities, Developers and CHSRA can be met

CHSRA staff are working to effectively collaborate with utilities and renewable energy developers. The utilities coordination staff have a strong understanding of CHSRA's needs and of how these needs impact negotiations with utilities and renewable energy developers.

CHSRA understands that the three listed actions are interrelated with each action having the potential to affect the others. This interrelatedness leads to the need to manage these activities in a comprehensive manner to ensure efficiencies and build on synergies between CAISO, utility, and renewable energy developer interactions. Developing a strategic renewable energy procurement plan requires extensive collaboration and can be supported through stakeholder engagement, internal and external working groups, and creation and selection of efficient and effective instruments for power procurement.

CHSRA will need to continue to gather and synthesize a significant amount of information to develop this plan. First, the CHSRA must decide on and adopt a net-zero approach. A feasibility study could be conducted to determine what renewable resources are available along the right-of-way to support this net-zero approach. CHSRA will need to decide how much renewable energy power will be used directly in operations (behind the grid) and how much could feed into the grid (both from onsite sources and through procurements with utilities and renewable energy developers). Conversations with utilities and developers will help establish how much renewable energy is likely to be available to procure, and at what cost. CHSRA will also need to continue conversations with CAISO and utilities to track what transmission and distribution will be available to receive and deliver power, as well as what infrastructure will need to be built.

⁷ These documents can be found on the CHSRA website at: <http://cahighspeedrail.ca.gov/assets/0/152/303/306/74c18464-fd2d-472d-9b87-08f142231c4c.pdf> (Chapter 2 Alternatives); and <http://cahighspeedrail.ca.gov/assets/0/152/303/306/f49770bd-113e-4909-b3a1-fa9ba67352d2.pdf> (Section 3.6 Public Utilities and Energy).

⁸ <http://www.ladwp.com/ladwp/cms/ladwp000851.jsp>

Instruments for strategic renewable energy procurement planning include:

- Request for Information (RFIs) and Request for Proposals (RFPs) when appropriate
- Power Purchasing Agreements (PPAs)
- Standard contracts for land leases
 - Consider including siting specifications to provide certainty needed for renewable energy developers to invest more quickly and without as many challenges
- A cohesive procurement policy will enable some streamlining of interconnection agreements with utilities
- Tariffs and Feed-in-Tariffs for renewable energy
- Work with State Regulators (CPUC) and Utility companies to establish statutes to allow regenerated energy to be fed back into the utility grid and allow CHSRA to obtain full credit.

Options for renewable energy procurement include:⁹

- Retail access (direct access)
- Participation in utility green energy options
- Voluntary wholesale agreements
- Behind the meter transactions
- Renewable Energy Credits (RECS)

The best instruments and options for strategic renewable energy procurement will vary depending on the specifics of the net-zero approach that CHSRA adopts and on the characteristics of the utilities and communities with which CHSRA is working. The choice of effective renewable energy procurement options will be dictated largely by the net-zero method that the CHSRA adopts, as well as by the availability and economics of onsite renewable energy and renewable energy procurement. At this stage of the planning process it is difficult to choose the best instruments and options for the detailed strategic renewable energy procurement plan since viable options have yet to be researched and fully vetted to determine the top option(s). Most likely a mix of these instruments and options will be the best plan and will be dependent on the local and regional regulations and resources.

Resources for strategic procurement

- **Examples of Standardized Interconnection Agreements**
www.ferc.gov/industries/electric/indus-act/gi/wind.asp

⁹ These procurement options were considered and summarized in the white paper created by the CHSRA – *White Paper on 100% Renewable Power for Operation of the CHSR*.

- **Information on Power Purchase Agreements**
http://www1.eere.energy.gov/femp/financing/pa_sampledocs.html
www.nrel.gov/docs/fy10osti/46668.pdf
www.nrel.gov/docs/fy11osti/51662.pdf

MINIMIZE ENERGY LOADS

The first step for any project powered by 100% renewable energy is to reduce energy consumption (also referred to as energy 'loads') as much as possible. CHSRA has championed reducing energy loads as much as possible for the traction power, systems and stations. CHSRA has set aggressive design parameters for energy use and will continue to work with contractors to minimize energy use.

Several stakeholders that were interviewed regarding planning activities for stations and trains supported this conclusion by stating that energy efficiency should be CHSRA's first consideration. It is important that CHSRA not only have an overall guiding principle to minimize loads but also should set goals and parameters that clearly define 'minimize.' Goals can be set by benchmarking the energy use of the most efficient rail systems around the world. Savings on propulsion and operations have been achieved at significant levels after certain processes and systems have been installed. CHSRA can use these efficient operations as a baseline energy use and challenge design teams and operations staff to identify new systems and processes to lower energy loads even further.

Taiwan High Speed Rail trains are all equipped with regenerative braking technology, enabling the system to achieve reduction in energy consumption and reduced wear on the mechanical braking systems.

Actions that will assist with lowering energy loads include:

Action Item: Minimize energy loads in trains

Setting design requirements for energy efficient trains for the HSR system is an ongoing activity. In general, energy loads can be minimized through design features such as minimizing the weight of bogies to reduce the weight of the train overall, utilizing regenerative features, more efficient heating, ventilation and air conditioning (HVAC) systems that utilize occupancy sensors and heat recovery, and utilizing energy efficient lighting, among others. The vehicle specifications will also require that the energy generated under train braking will be of sufficient quality to allow it to be fed back into the system for other trains to use or to be fed back to the grid for other customers.

The HSR substations are being specified to have space for filtering equipment if deemed necessary for feeding back to the transmission network. CHSRA is currently engaging manufacturers to pursue the most efficient rolling stock and systems.

Action Item: Minimize energy loads in HSR Facilities

Achieving minimal energy loads requires aggressive design parameters, such as preference for net-zero energy buildings that challenge designers and contractors to cost-effectively meet a new level of energy performance in their designs and construction.¹⁰ Design direction with clear, ambitious energy savings parameters will push the envelope of convention and encourage innovation. Integrating the design process and holding charrettes with energy modelers, architects and contractors where net-zero energy use is the end goal for all stations and maintenance facilities will also propel further advancement.

Possible next steps include:

- Review existing concept designs for energy efficiency and load requirements,
- Invite energy modelers, architects, contractors, CHSRA board members, etc to a one-day charrette to discuss design priorities and options and clarify goals and approaches,
- Continue research into wayside energy storage systems to help offset the high peak loads of the trains.
- Update design criteria with specifics about net-zero energy goals and preferred strategies, and
- Establish a contracting mechanism that requires net-zero energy building performance within a designated budget as the end-goal of all station and facility design.

Resources for minimizing energy loads

- **NREL's Net-Zero Research Support Facility**
http://www.nrel.gov/sustainable_nrel/rsf.html
- **Consortium for Energy Efficiency: Energy Efficiency RFP Guidance**
http://energytrust.org/library/reports/100603_Energy_Efficiency_RFP_Guidance.pdf
- **Architecture 2030 Case Studies**
http://architecture2030.org/2030_challenge/case_studies
- **International Living Buildings Institute**
<https://ilbi.org/lbc/LBC%20Documents/LBC2-0.pdf>

¹⁰ Net-zero energy buildings are those that are designed to be energy efficient and generate as much energy as is consumed over the course of a year, generally through on-site renewable energy technologies.

INTEGRATE ONSITE RENEWABLE ENERGY

Renewable energy generation on HSR facilities and right of way (ROW) should be considered once energy loads have been reduced as much as possible through sustainable and energy efficient design elements. Onsite renewable energy integration is ideal due to the fact that the transmission and distribution losses associated with renewable energy that is sited farther away from energy consumption is avoided. Renewable energy should be integrated along the ROW and at stations and facilities, where most viable.

To guide the integration of onsite renewable energy CHSRA could develop and adopt a customized cost/benefit analysis to consider both the upfront capital costs of renewable energy integration and the long-term operational savings and other benefits. CHSRA could set an upper range of costs it would be able to absorb or could set a minimum pay-back ratio regarding onsite renewable energy. In addition, CHSRA could explore partnerships with communities or agricultural stakeholders to increase capital that is available to invest in renewable energy that makes sense on a larger scale and that is available onsite and along the CHSRA ROW. The ability to include a wider range of benefits by involving the community as well as the ability to spread some costs may allow for a much greater amount of renewable energy to be sited at stations or along the rail system. Actions for integrating renewable energy into the train system include:

Action Item: Develop a Customized Cost/Benefit Analysis for onsite renewable energy that identifies the limits of CHSRA's financing options

CHSRA could conduct a detailed resource study to analyze the availability and viability of onsite renewable energy.



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This study would identify specific renewable energies located onsite and within the designated ROW and their estimated costs for delivery to the grid and/or the HSR system. Currently specifications are being developed to include renewable generation devices such as small windmills or PV panels at wayside equipment shelters to keep batteries charged and operate low power devices. Other areas that demonstrate potential for large-scale renewable energy generation for larger loads would be identified and analyzed further to determine the feasibility of joint investments with local communities and organizations.

A customized cost/benefit analysis study can guide CHSRA's determination of how much renewable power to use onsite and how much renewable power to feed into the grid by demonstrating the economics of renewable power generation and delivery.

By carefully designing the study the CHSRA can achieve several objectives that include:

1. Identifying onsite renewable energy,
2. Determining the likely economics of generation and delivery for renewable energy,
3. Identifying onsite options that warrant further studies (reliability analysis for behind the grid applications), and
4. Identifying onsite options that present joint investment opportunities to lower the CHSRA's initial capital investment costs and increase the benefits to local communities (thereby creating a more economically attractive option).

This study would likely have low, medium, and high cost estimates to provide a proper range of analysis for CHSRA to make sound decisions regarding onsite renewable energy placement. In addition, the study would likely capture the rapidly decreasing cost of solar and the affect of this decrease on the economics of onsite PV installations – especially for facilities that will not be built for another 5-7 years.¹¹

The cost/benefit analysis of joint investment opportunities will also provide a mechanism for a more accurate assessment of renewable energy benefits by taking into account a wider range of benefits for local communities. This broader analysis aligns with the CHSRA's emphasis on sustainability and the long-term viability of the system.

One stakeholder suggested developing comprehensive energy plans to develop renewable energy generation at stations to share the benefits (the energy) with communities, building goodwill. This stakeholder also emphasized the importance of a staged approach to development and for delineating clear 'plug-in' locations so that desirable options are not precluded in the future.

Action Item: Integrate renewable energy technologies along the ROW

Early action would enable renewable energy technologies to be integrated into the infrastructure and ROW of the HSR system. Detailed feasibility studies will need to be conducted along the ROW to determine where renewable energy generation will be most viable. Technologies will vary depending upon the resources available, therefore analysis needs to be conducted and discussed with design engineering team(s) to determine where possibilities lie. Renewable energy may be incorporated along the ROW where operationally feasible.

Possible next steps include:

- Conduct a detailed siting study to determine feasibility of accessing renewable energy within the ROW, and
- Create a working group to discuss the options for siting renewable energy along the ROW. The working group should be comprised of industry professionals from renewable energy developers to rail designers, utilities, and renewable energy policy makers.

Action Item: Integrate renewable energy technologies into HSR facilities

Integrating renewable energy technologies into station and depot design requires additional actions to complement current design guidance. As with the integration of renewable energy in the train system, detailed resource studies will need to be conducted. Technologies will vary depending upon the resources available. Where technologies such as ground source heating and cooling are possible, the technology will need to be discussed with architectural engineers to integrate the technology with the HVAC design. Technologies such as building-integrated PV should be considered with designers, as well. Ancillary technologies can be added to the buildings over time, but architects should plan for these technologies during the design phase when it is often more cost effective to include needed equipment for later installation of PV panels. In addition, buildings should be structurally sound to support later integration of roof-mounted PV or wind turbines, when later installation is likely to be desirable.

¹¹ Ecofys, The Energy Report: 100% Renewable by 2050. Ecofys Online Text Archive (2011). Online at: http://www.ecofys.com/files/files/ter_fullreport_lesres_2011-02-02_000.pdf

Possible next steps include:

- Conduct a detailed renewable energy siting study for facilities,
- Convene a working group comprised of architectural engineers, renewable energy experts and developers to discuss incorporating renewable energy technologies into facility designs,
- Create a long-term development plan for incorporating appropriate renewable energy technologies into HSR facilities if inclusion in original design is cost-prohibitive, and
- Work with developers and manufacturers to purchase technologies at cost or in bulk, where possible.

Resources for incorporating renewable energy

- **Integrating Renewable Energy into Buildings**
www.epa.gov/greenpower/pubs/onsite.htm
www.nrel.gov/docs/fy00osti/25272.pdf
www.pnnl.gov/main/publications/external/technical_reports/PNNL-20442.pdf

Goal: Foster a Robust, Sustainable Economy in California

CHSRA's goal of fostering a robust, sustainable economy in California presents the potential to boost economic development and create local jobs for communities. CHSRA recognizes that the rail system implicitly requires an extensive planning process. Thoughtful planning of the HSR has the potential to shift development patterns toward sustainability. This shift requires integrated community and regional planning that supports multimodal transportation networks to ensure optimal results for connectivity, ease of use and energy conservation.

CHSRA has signed a Sustainability Planning Partnership MOU with the Environmental Protection Agency (Region 9), Department of Housing and Urban Development (Region 9), Federal Transit Administration (Region 9), Department of Transportation, and the Federal Railroad Administration. This MOU positions CHSRA to lead the nation in sustainable transportation. CHSRA is providing grant funds to cities where stations are located so that cities can begin to integrate the stations into their local planning and fully leverage the economic and livability benefits of the new infrastructure. In addition, CHSRA is considering several options for education, outreach, and community involvement in planning and building the HSR system.

Strategies

DEVELOP LOCAL AND REGIONAL NETWORKS AND PLANS

The HSR project is an extensive infrastructure project that will have profound effects on the communities it touches. The HSR cannot be successful without support from state, regional, and local communities. To ensure all stakeholders have the information needed to make a sound assessment of the rail system, in addition to the past few years of information sharing and public involvement, CHSRA has been planning additional outreach and educational campaigns.

CHSRA is not only talking about community involvement, but is actively supporting communities through grant funds. The ultimate goal of fostering a robust, sustainable economy will require careful planning and a thorough consideration of all interests to ensure the long-term viability of present day actions.

Action Item: Assist with and support the development of Station Area Plans

CHSRA is working with local jurisdictions to develop plans for the areas surrounding stations. While CHSRA will lead the development of the stations, planning and development of the area surrounding the stations is the responsibility of each local jurisdiction with the CHSRA participating as an interested stakeholder. Station Area Plans will be context-sensitive and facilitate mode shift, livable urban design, infill and sustainable development that supports the HSR system. CHSRA is providing financial support for these efforts through Station Area Planning Grants. CHSRA will be providing station-specific guidance as well as statewide station area planning guidance.

As part of this effort, local organizations and jurisdictions will be identifying local and regional developers and businesses that are interested in locating within or around stations. This identification of key players will assist with educating the public about the HSR system and what it can mean for their community, as well as providing transparency in the planning process. In addition, the identification of possible partners and development of mutually beneficial partnerships to spur economic development in and around stations will improve the longevity of stations and increase community support.

Station area planning activities may include the following actions by CHSRA and local jurisdictions:

- Hold community forums for interested stakeholders and the general public,

- Conduct targeted outreach to businesses and developers to gauge interest and needs, and
- Work with local chambers of commerce to ascertain local business needs and provide information regarding economic development opportunities in and around stations.

These activities will provide a platform for collecting information and allow businesses and local communities to voice their opinions and concerns and provide input regarding their needs.

Action Item: Support increased multimodal access to Station Areas

In order for stations to be successful multimodal access is essential, especially for stations located in central, well-developed areas where parking space is constrained due to land availability and cost. CHSRA will work with local and regional governments and transportation providers to integrate HSR stations with the current public transportation infrastructure and to provide safe and welcoming pedestrian and bicycle access to stations that offers viable and attractive alternatives to private vehicle access. Connectivity throughout a station's region created by thoughtful integration of current transit and new stations is what makes public transit a success. By providing attractive and convenient alternatives for station access, transportation options for the station's region are enhanced and are likely to reduce the overall reliance on single-occupant vehicles.

Advocating for multimodal access and transit connectivity activities may include:

- Working groups with local and regional transportation providers and stakeholders,
- Support of federal, state and local transit, capital and operations, and active transportation funding, and
- Researching the varying markets for transit and other alternative modes of transportation in each station region and developing regionally/locally tailored programs and incentives to support these markets.

Action Item: Align local and regional planning with zoning and permitting requirements

CHSRA will work with local, regional and state authorities to develop streamlined permitting and environmental review for station area development that allows for a variety of uses, more livable development patterns and sustainable construction. Streamlined permitting, aligned to full environmental compliance, reduces risks for potential investors and will therefore increase the desirability of developing in the area.

Aligned development is necessary for localities to fully capture the value of the new infrastructure and to maximize community support of the HSR. Station Area Planning will aim to ensure benefits come to the community; will enable the development needed to facilitate the success of the HSR system; and will look to encourage development within and around stations.

Alignment of permitting and zoning activities may include:

- Working groups that involve local and regional authorities (public transportation and land use), and developers (real estate and renewable energy),
- Analyzing opportunities for new environmental procedures that could include abridged environmental impact procedures in the station area,
- Aligning incentives for infill development consistent with SB 375, and
- Assisting local municipalities in finding resources to develop zoning/permitting codes that encourage mixed use, livable, sustainable development, etc.

Action Item: Comprehensive Community Energy Plan Development

CHSRA is considering the possibility of spurring the creation of local and regional working groups to develop comprehensive community energy plans for areas around the stations.¹² The community energy plans could be developed in conjunction with streamlining zoning and permitting for real estate and renewable energy development. The desired outcome of this action item is not only to develop a community energy plan but also to identify renewable energy developers interested in community projects; to identify community groups interested in investing in renewable energy projects; and to build support for the HSR by creating and identifying ancillary benefits for communities.

Comprehensive community energy planning may include:

- Targeted outreach to community groups to gauge interest in active participation, such as the ability to fund community solar gardens or other renewable energy projects. These projects can provide power for the community and the HSR,¹³
- Develop working groups involving local officials, community groups and renewable energy

¹² The development of comprehensive community energy plans was suggested by one of the interviewed stakeholders.

¹³ Some key considerations are the limitations created by CA's regulation of direct power purchases – IPPs/renewable energy developers may not be able to contract directly with CHSRA (CHSRA may need to go through utilities to procure renewable energy) and whether CA allows for community solar project funding (relevant legislation).

developers to outline comprehensive community energy plans, and

- Provide references and information to local communities through station area planning activities to invest in solar gardens or other renewable energy projects to power the rail system as a shared community resource with community support.¹⁴

The San Joaquin Valley as an Energy Shed

The possibility of pairing CHSRA's need for renewable energy procurement with the San Joaquin Valley dairy community's supply of animal waste presents an opportunity to serve both parties with one solution, thus creating a win-win situation.

Waste to Energy (WTE) is one of the fastest growing renewable energy technologies. WTE has the unique and attractive characteristic of being a renewable energy fuel source that is able to provide baseline generation. This characteristic makes WTE an attractive renewable energy procurement option for CHSRA and is likely to enable a greater portion of the HSR system to be powered directly by renewable energy.

The Valley's economy has traditionally been centered solely on agriculture and the current situation creates the potential to turn the Valley into an energy -shed as well as a food-shed. This diversification will strengthen the valley's economy and will likely increase support for the HSR in rural areas by providing a mutual benefit to the community.

The most economical WTE plants are at 10MW or greater (~300tons/day). Initial estimates for optimal sizing and required annual fuel amounts will need to be conducted as well as predicted effects on air quality to determine whether such a facility is feasible while stakeholder engagement and outreach can determine desirability.

¹⁴ One stakeholder from the Central Valley suggested a feasibility study of powering the train with power generated by dairy farm waste.

Resources for developing networks and plans

- **High-Speed Train Station Area Development: General Principles and Guidelines**
www.cahighspeedrail.ca.gov/highspeedtrain_stationdev_policies.aspx
- **California High-Speed Rail Project: Urban Design Guidelines**
www.cahighspeedrail.ca.gov/urban_design_guidelines.aspx

FORM STRATEGIC PARTNERSHIPS

Partnerships will involve a more formal alliance than the networking activities discussed previously. Partnerships may be formed with cities, local community groups, local business, renewable energy developers, or with regional transportation organizations.

The goal of these partnerships will be to establish common goals between CHSRA and local communities, businesses and transportation authorities. Successful partnerships would allow for both CHSRA and its partners to more effectively provide benefits (reinforcing green jobs and local economic development) to local and regional economies by pooling resources and working toward a common goal.

Possible next steps include:

- Form topical and/or geographic strategic partnership working groups with a representative from each key stakeholder identified. Topics could include station area planning and development, regional planning, energy planning,
- State-level working groups should evaluate potential bottlenecks and strategize solutions,
- Hold monthly or quarterly discussions to outline, edit, review comprehensive energy plans and development plans for communities along the rail corridor to ensure business and real estate development around the stations is beneficial to each community,
- Coordinate regional transportation planning with an eye toward partnerships for integration and building multi-modal transportation hubs,
- Streamline contracting where possible to remove unnecessary challenges to businesses and developers where community support is strong,
- Align CHSRA objectives with those of local communities and with state initiatives to leverage government funding and support local economic development, and
- Investigate viability of siting renewable energy generation on brownfield sites to preserve pristine land, maximize benefits for California, and potentially reduce costs.

Resources for strategic partnerships

- **U.S. Environmental Protection Agency Clean Energy Local Programs Best Practices**
<http://www.epa.gov/cleanenergy/energy-programs/state-and-local/local-best-practices.html>

Goal: Enact Best Practices for Energy Sustainability

CHSRA strives to deploy best practices for sustainability. To do this effectively, CHSRA could adopt topic specific policies under the umbrella of a sustainability approach to guide energy planning and procurement activities. Specific policies that have been discussed briefly earlier in the SEP include the cultivation and refinement of their renewable energy policy approach that will guide the strategic renewable energy procurement plan, the goals and parameters that will define minimizing energy loads and the cost/benefit analysis that can guide investments in onsite renewable energy projects. Each of these items would fall under one of the topic specific policy areas to be discussed in this section. The two key strategies recommended for achieving best practices in energy sustainability are: establishing energy sustainability policies in each topic-specific area listed for CHSRA and aligning energy planning and permitting activities to remove barriers, dovetail processes and lower overall costs.

First, CHSRA will need to finalize topic-specific policies to guide energy planning and implementation activities. The topic-specific policy areas that should be addressed include: facilities and infrastructure; train and station design; and operations and procurement. Once desirable policies have been identified, institutional and regulatory obstacles that may hinder or prevent full implementation of these policies should be identified. In addition, any overlaps in policies and activities should be identified to better align energy planning and permitting activities. This alignment will ultimately lower costs for the construction and operations of the HSR system.

Strategies

ESTABLISH TOPIC-SPECIFIC, ENERGY SUSTAINABILITY POLICIES

Organizational policies provide guidance and reinforce commitment to a goal both internally and externally. Adopting discrete policies under the umbrella of CHSRA's sustainability approach will lay the foundation for setting industry standards for a sustainable high speed rail system in planning, design, delivery, operations, and management.

Specific topic areas for energy sustainability should address facilities and infrastructure; train and station design; and operations and procurement procedures. Each policy will contribute to making the HSR system a model of best practices to achieve energy sustainability through efficiency and clean energy use and should be created using expert advice and contribution as needed, and with the input and active participation of relevant staff within each topic-specific area.

Action items are summarized briefly as follows:

Action Item: Develop and implement a 'green' facilities and infrastructure policy

To accomplish net-zero energy facilities, CHSRA will need to develop and implement a net-zero energy and green facility policy. This policy should include guidance for developers on achieving net-zero energy, conserving water, and using sustainable materials in construction.

Considerations include:

- Customized cost/benefit analysis of onsite renewable energy projects/integration, and
- Customized cost/benefit analysis of proposed facility and infrastructure sustainability strategies.

Action Item: Develop and implement a policy to investigate viable options for siting of renewable energy infrastructure on brownfield sites

To maximize benefits from this project to California, CHSRA can investigate the viability of renewable energy development on under-utilized or contaminated lands. Due to historic contamination, some land parcels are suitable for renewable energy generation but are not



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desirable locations for other uses. Siting renewable energy generation at these locations can preserve ecologically sensitive and agricultural lands by lessening renewable energy development pressures on these areas. In addition, the lower costs involved in leasing or buying brownfield sites for renewable energy development may result in lower energy costs for the CHSRA.

Considerations include:

- Partnering with DOD, EPA, DOE and other federal agencies who may have access to appropriate sites
- Engage organizations focused on siting renewable energy on brownfields, such as Re-Power America
- Assessing any complexities that may arise from unique conditions of the site or any restrictions imposed on use of the land

Action Item: Finalize and implement a functional transportation integration policy

A functional transportation integration policy will be dependent upon a number of options and discussions with stakeholders.

Considerations include:

- Integration with current transportation networks,
- Access for pedestrians and bicycles,
- Determine where to locate and develop resources outside of the rail system, and
- Convenience and accessibility of HSR stations through alternative transportation.

Action Item: Refine a goal-driven train design policy with specific design parameters that builds upon current train design activities and principles

To accomplish further demand reduction, CHSRA will need to refine the policy for design and procurement of trains. This policy should include guidance for designers and purchasers to achieve low energy consumption requirements for reducing energy loads as much as possible. Specific guidelines should be established for design features such as bogie weight, HVAC controls or sensors, and miles per kW of energy consumed by the train. This type of policy is discussed briefly on p. 8 under the minimize energy load strategy.

Considerations include:

- Use of benchmarks set by the most efficient train sets currently available as baseline design parameters,
- Efficiency of propulsion through regenerative braking (i.e., what is current efficiency? Will CHSRA attempt to increase this efficiency?),

- Train capacity (e.g., how to maximize passenger capacity and remain compliant with Americans with Disabilities Act (ADA) requirements?), and
- Maximum speeds (e.g., balance time savings and energy expended, the train does not need to travel at constant speed between stops, etc).

Action Item: Continue to implement an efficient operations policy

CHSRA has already benchmarked HSR operations globally, and has used that data to develop appropriate performance criteria for the HSR system. The development of the operations performance requirements has been done through a systems engineering approach, integrating the major components of the rail project: infrastructure, systems, rolling stock and operations, choreographed to achieve safe, cost-effective operations in the most efficient manner possible.

Action Item: Finalize and implement green procurement policy

To embed energy efficiency goals into ongoing procurement, CHSRA will need to finalize a procurement policy for operations, materials and trains. This policy will be separate and distinct from the strategic renewable energy procurement policy. This policy should provide guidance to procurement staff for purchasing efficient and/or sustainable materials to further the environmental standards of the HSR project.



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Resources for finalizing and implementing energy sustainability policies

- **Green Operators Program**
<http://www.uprr.com/she/emg/index.shtml>
- **International Union of Railways**
<http://www.uic-sustainability.org/spip.php?article31>

- **State of California**
<http://www.dgs.ca.gov/Default.aspx?alias=www.dgs.ca.gov/buyinggreen>

ALIGN ENERGY PLANNING AND PERMITTING ACTIVITIES TO DOVETAIL PROCESSES AND LOWER COSTS

Certain institutional and regulatory obstacles are likely to challenge CHSRA in achieving specific energy goals integral to the operation of a sustainable high speed rail system in the United States. A comprehensive inventory of these obstacles is required, along with further analysis to determine the impact on the HSR project.

Action Item: Identify and inventory institutional and regulatory obstacles that are likely to affect the implementation of CHSRA energy policies

CHSRA should compile a comprehensive inventory of regulations and their impacts on the HSR project. A few examples of these obstacles include:

- Weight regulations for trains set by the Federal Railroad Administration (FRA),
- Applicable regulations for the CHSRA high-voltage lines that are not covered by current California Public Utilities Commission (CPUC) regulations or state legislation,
- ‘Buy American’ provision regarding the use of federal/state funds to purchase train equipment.

Action Item: Prioritize obstacles according to their likely impact on the success and sustainability of the HSR project

Once a list of institutional and regulatory obstacles has been compiled – these obstacles should be ranked according to their likely impact. Those obstacles that have a high impact and a large likelihood of occurring should be the top priorities for CHSRA. This activity is analogous to a risk assessment exercise and will allow CHSRA to effectively address obstacles by creating a focus around those that present the biggest potential of having a negative impact.

Action Item: Collaborate with relevant stakeholders to address obstacles

CHSRA is already working with key stakeholders such as utilities, CAISO and the FRA to address currently identified barriers. The preceding actions listed in this section may reveal additional obstacles that need to be addressed.

Considerations include:

- **Working groups**
Continue working group meetings to support ongoing negotiations with the Federal Railroad

Administration (FRA) regarding weight regulations for trains. The need for lighter-weight trains to increase efficiency must be balanced with adequate safety regulations. This balance is a key to maximizing the success of the HSR and its efficiency goals while maintaining safe operations.

- **Coordinate with ISO and CA PUC to address regulations**

CHSRA will need to continue to coordinate with ISO and the CA PUC to address regulations around new technologies. CHSRA will also need to track the PUC’s treatment of direct power procurement options to understand their opportunities for procuring renewable energy from independent power producers (IPPs) and renewable energy developers.

- **Continue working with the FRA on the newly added ‘Buy American’ provision and a possible exemption for high-tech/state of the art equipment**

CHSRA should continue to work with procurement staff and lobby for a special clause exempting purchase of high-tech/state of the art equipment required to operate an efficient train system, currently not available from American manufacturers.

Resources for planning and permitting processes

- **Government Permitting Best Practices**
http://www.ora.wa.gov/documents/lgp_best_practices_report.pdf
- **National Best Practices**
<http://www.newdesignsforgrowth.com/pages/smartgrowthresources/nationalbestpractices.html>
https://www.communicationsmgr.com/projects/1355/docs/Zoning_BPs_whole.pdf